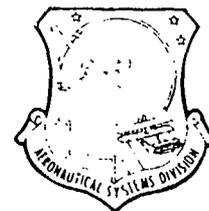


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A COMPARISON OF AIR FORCE VERSUS FEDERAL AVIATION
ADMINISTRATION AIRFRAME STRUCTURAL QUALIFICATION
CRITERIA: MIL-A-87221 (USAF) VS. FAR PARTS 23 AND 25

AD-A180 922

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Structures Division
Directorate of Flight Systems Engineering

August 1986

Final Report for Period 15 August 1984 - 15 August 1986

Approved for public release; distribution unlimited

DEPUTY FOR ENGINEERING
AERONAUTICAL SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-6503

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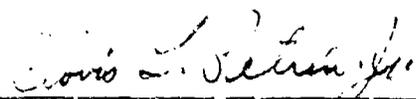
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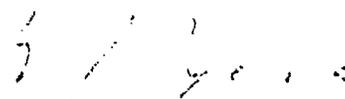
This report has been reviewed by the Office of Public Affairs (ASD/PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.


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19. ABSTRACT (Continue on reverse if necessary and identify by block number) The FAA organization and certification policies and procedures as they apply to aircraft structures are briefly reviewed. Differences between the military specifications and federal aviation regulations are addressed in general, followed by a comparison of the new USAF Airplane Strength and Rigidity specification (MIL-A-87221) with FAR 23 and FAR 25 requirements.			
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11. A COMPARISON OF AIR FORCE VERSUS FEDERAL AVIATION ADMINISTRATION AIRFRAME STRUCTURAL QUALIFICATION CRITERIA: MIL-A-87221 (USAF) VS. FAR PARTS 23 AND 25.

FOREWORD

Air Force acquisitions of "off-the-shelf" commercially developed aircraft for use in cargo, tanker, transport, and trainer roles have made it essential that the capability be developed within ASD acquisition organizations to evaluate commercially developed aircraft designs for adequacy in meeting Air Force requirements.

Development of this capability to evaluate commercial aircraft designs has been complicated by a lack of understanding of the differences in the design approaches embodied in Air Force and Federal Aviation Administration airframe qualification procedures. This report is intended to provide an insight into Federal Aviation Regulation Parts 23 and 25, the FAA regulations which govern airplane qualification and certification, including airframe structures. This report is intended primarily for use by ASD engineers familiar with Air Force regulations and specifications governing aircraft structural design, particularly MIL-A-87221(USAF).

ASD-TR-85-5106, dated March 1986, comparing FAR Parts 23 and 25 to the MIL-A-00886X series of military specifications was developed under ASD/XOR Project 82-128-HOU. This report has been developed under ASD/XOR Project 84-228-HOU.

The Air Force Project Engineer for this report is Mr. Walter P. Dunn, ASD/ENFS, ext. 52576. The Air Force Project Sponsor is Mr. Clovis L. Petrin, ASD/ENFS, ext. 52415.

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SECTION 1.0

FAA ORGANIZATION AND CERTIFICATION POLICIES AND PROCEDURES

1.1 THE FEDERAL AVIATION ADMINISTRATION

The Federal Aviation Act of 1958 was signed into law by President Eisenhower on August 23, 1958. The Federal Aviation Agency (later renamed Administration) assumed its statutory responsibilities on December 31, 1958.

The responsibility given to the Federal Aviation Administration (FAA) under the 1958 Act for the type certification of aircraft, engines, propellers and appliances is accomplished by the Washington and regional offices of the FAA. This is stated in FAA order 8110.4.

FAA order 1100.2A defines the mission of the FAA as:

- a. The regulation of air commerce in such manner as to best promote its development and safety and fulfill the requirements of national defense.
- b. The control of the use of navigable airspace of the United States and the regulation of both civil and military operations in such airspace in the interest of safety and efficiency of both.
- c. The promotion, encouragement, and development of civil aeronautics.
- d. The consolidation of research and development with respect to air navigation facilities.
- e. The installation and operation of air navigation facilities.
- f. The development and operation of a common system of air traffic control and navigation for both civil and military aircraft.
- g. The development and implementation in coordination with other departmental elements and other Federal agencies, of a program to achieve a system solution to the aircraft noise and sonic boom problem.

The wartime service of the FAA outlined by order 1100.2A is stated as:

- a. The wartime mission of the Federal Aviation Administration is to support the Department of Defense and appropriate military commanders through air traffic control, aeronautical communications, aids to navigation, and other essential services; to support essential civil aviation

operations, including preservation and restoration of the capability of the civil air transport system; support of civil government, civil survival and recovery operations; and to provide for the protection of FAA personnel and the continuity of executive direction and for safety and survival of FAA personnel.

b. Executive Order 11161 contemplates that the Federal Aviation Administration will be transferred to the Department of Defense in event of war and will function as an adjunct of the Department of Defense. It is further contemplated that while functioning as a adjunct of DoD, FAA will remain organizationally intact and the Administrator will retain responsibility for administration of statutory functions.

The following several pages are extracted from FAA Order 1100.2A and detail the functions of the Office of Airworthiness in Washington D.C. After that section, a portion of FAA order 1100.2A has been included to discuss the functions of the various FAA Regions.

The Commerce Department and then the Civil Aeronautics Administration (CAA) used various rules prior to the forming of the FAA and the Federal Aviation Regulations (FAR). The current (1985) FAR 23 and FAR 25 were used for the following comparison of the subject MIL specification to civil requirements. FAR 23 is the certification criteria for aircraft weighing 12,500 pounds or less. FAR 25 is the certification criteria for aircraft weighing more than 12,500 pounds, referred to as transport category.

1.2 INFORMATION FROM FAA ORDER 1100.2A

1.2.1 CHAPTER 63. OFFICE OF AIRWORTHINESS

6300. MISSION To promote safety in air commerce by assuring the air-worthiness of civil aircraft, including aircraft design type certification; production certification; airworthiness certification; approval of operators' aircraft maintenance programs; airmen certification; air agency certification; and continued airworthiness programs.

6302. FUNCTIONS

a. The office of airworthiness is the principal staff element of FAA with respect to:

(1) Design-type certification or approval of civil aeronautical products (aircraft, aircraft engines, propellers, materials, parts and appliances).

(2) Production and original airworthiness certification of civil aeronautical products.

(3) Implementation of bilateral airworthiness

agreements between the U.S and foreign governments for the reciprocal acceptance of civil aeronautical products.

(4) Continued airworthiness and maintenance standards for U.S. registered aircraft.

(5) Examination and certification of airmen (holders of inspection authorizations, mechanics, repairmen, and parachute riggers) and air agencies (repair stations, parachute lofts, and aviation maintenance technician schools).

(6) Approval of, and surveillance over the aircraft maintenance programs of operators and pilot schools.

(7) Examination and appointment of private persons, including companies, designated and authorized to act as a representative of the Administrator, pursuant to the provisions of section 314 of the Federal Aviation Act, with respect to aircraft-design type certification, production certification, airworthiness certification, and maintenance of civil aeronautical products.

(8) Identification and marking of civil aeronautical products for airworthiness control (excludes registration).

b. With respect to the foregoing, the office of airworthiness:

(1) Develops and recommends, or issues within the delegated authority of the director, regulations, and minimum standards.

(2) Develops and recommends national policy for issuance by the Administrator.

(3) Develops the issues guidance, procedures, practices and program plans consistent with national policies.

(4) Develops and recommends specific program goals and areas of emphasis to guide field program planning and performance.

(5) Evaluates the adequacy of existing regulations, policies, procedures, practices, and program performance in meeting broad FAA goals as well as specific program goals.

(6) Recommends budget levels for formulation of decision packages on national programs, and recommends allocations of appropriated resources based on review of the regional responses to the call for estimates and quarterly review information.

(7) Develops and recommends programs and practices to ensure the professional competency and development of employees.

(8) Determines the need for and recommends research and development projects, establishing the relative priority of those projects recommended.

6303. SPECIAL DELEGATIONS

a. Final authority is delegated to the Director of Airworthiness, to make, issue, amend, and terminate regulations and minimum standards promulgated under Titles III and VI of the Federal Aviation Act relating to the following subject matters:

(1) Appendices to Federal Aviation Regulations within the purview of the Office of Airworthiness.

(2) Technical Standard Orders for aircraft materials, parts processes, and appliances.

(3) Withdrawn - CHG 19.

(4) Special Conditions as set forth in sections 21.16 and 21.101 of the Federal Aviation Regulations for products type certificated under section 21.23 and Part 31 of the Federal Aviation Regulations.

b. With respect to the functional areas of paragraph 6302a, final authority is delegated to the Director of Airworthiness.

(1) To grant or deny exemptions from regulations and minimum standards.

(2) To issue, amend, extend, or withdraw notices of proposed rulemaking.

(3) To grant or deny exemptions for foreign aircraft and airmen from regulations promulgated under the provisions of section 610(a) of the Federal Aviation Act, as provided for by section 610(b) of the Act.

(4) To take final action on any request for reconsideration of original issuance, amendment, or refusal to issue or amend an airman certification, or air agency certification; including the resolution of controversial findings related to the certification in question.

(5) To take final action on any petition for reconsideration of original approval, amendment, or a refusal to approve or amend an operator's maintenance programs to be included in an Operations Specification.

(6) To grant or deny exceptions from the definition of "airmen" under section 101(7) of the Federal Aviation Act to individuals employed outside the U.S. who are directly in charge of inspection, maintenance, overhauling or repair of aircraft, aircraft engines, propellers, appliances, and components.

c. The authority of paragraphs 6303a and 6303b may not be redelegated.

6304. SPECIAL RELATIONS

a. Regulations. The Office of Airworthiness is responsible for the substantive content of regulations and minimum standards within the office's purview, as distinguished from the responsibility of the Office of the Chief Counsel for legal adequacy of rules.

b. Maintenance Airmen Certification. The Office of Airworthiness provides program plans, objectives, technical guidance, and criteria applicable to maintenance airmen certification activities conducted at the Aeronautical Center and conducts program performance evaluation of these activities.

c. Environment and Energy. The Office of Airworthiness is responsible for matters concerning the application of aircraft noise, sonic boom, fuel venting, and exhaust emissions regulations in the type certification and airworthiness certification of aircraft, as distinguished from the responsibility of the Office of Environment and Energy for the substantive content of regulation within its purview. The Office of Environment and Energy also provides technical support to the Office of Airworthiness in the development of field guidance for the implementation of aircraft noise, sonic boom, fuel venting, engine emissions, energy conservation, and other aviation-related environment regulations policies.

d. Airworthiness Directives. The Office of Airworthiness reviews the substance of and recommends final action by the Administrator on petitions for reconsideration of Airworthiness Directives made pursuant to section 11.93 of the Federal Aviation Regulations. The recommendation for final action will be coordinated with the director having responsibility for the aeronautical product affected and the Office of the Chief Counsel before the recommendation is forwarded to the Administrator.

e. Aircraft Certification Directorates. The Office of Airworthiness will maintain cognizance of, and participate in, the technical aspects of regulatory and policy actions in progress within the directorates to promote consistency across directorate lines, and to provide staff support to the Administrator in reviewing and evaluating the overall effectiveness of national aircraft certification programs. National type certification policy guidance and procedures common to all directorates as contained in orders, handbooks, and other advisory material will be issued by the Director of Airworthiness when there is a compelling need for standardization and after coordination with the directorates and other affected delegations of rulemaking authority are made to the Director of Airworthiness and the directors of the Aircraft Certification Directorates.

6305. OFFICE OF THE DIRECTOR The Office of the Director:

a. Advises and assists the Associated Administrator for Aviation Standards by providing support in the justification of budget estimates, in the administration of executive decisions, and in the development and maintenance of productive relationships with the public, the aviation community, and other Government agencies.

b. Provides for the development and coordination, and is accountable to the associate administrator for the adequacy of:

- (1) FAA regulations and minimum standards;
- (2) Policies guidance, procedures and practices.
- (3) Program plans and guidelines issued by or on behalf of the Administrator.

c. Provides for effective evaluation of program performance and ensures the adequacy of follow-up to assure correction of deficiencies.

d. Assures that all elements of the Office of Airworthiness participate constructively in the FAA Equal Employment Opportunity Action Plan and in equal employment opportunity planning for the future.

6306 - 6309 RESERVED (Not Applicable)

6310. AIRCRAFT ENGINEERING DIVISION

a. This division is responsible for national type certification policy and procedures common to all directorates; and design type certification for those FAR Parts not assigned to the directorate.

b. With respect to the foregoing, the division:

(1) Assesses the justification for, and evaluates the technical substance of Federal Aviation Regulations, Appendices to Federal Aviation Regulations, Technical Standards Orders, Special Conditions as set forth in Parts 21.16 and 21.101 of the Federal Aviation Regulations.

(2) Recommends granting or denying exemption petitions.

(3) Supports rulemaking actions by providing or arranging for technical specialist participation.

(4) Develops, coordinates, and recommends national policies.

(5) Develops, coordinates, and issues national

directives to provide technical guidance on procedures and practices.

(5) Serves as a point of contact for the public on issues appropriate to the national level.

(7) Conducts evaluations and analyses of field program accomplishment.

(8) Assesses the need for and recommends priorities on research and development activities.

(9) Assigns special technical projects, recommends priorities, and provides broad policy and program guidance to ensure the adequacy of national type certification activities performed by the Aviation Standards National Field Office.

(10) Represents the Office in international meetings to further U.S. interests and to develop International Standards and Recommended Practices for ICAO.

(11) Represents the Office in matters concerning the development of international agreements, arrangements, policies, and practices design type certification of civil aircraft and related products.

c. Withdrawn - CHG 19.

d. Processes petitions for reconsideration of Airworthiness Directives made pursuant to section 11.93 of the Federal Aviation Regulations.

e. Withdrawn - CHG 19.

f. Develops, coordinates, and recommends career development programs to assure organizational competency, for aerospace engineers (GS-861) and flight test pilots (GS-861/2181).

g. Withdrawn - CHG 19.

h. Provides the following program support functions to the office, and to all divisions therein:

(1) Withdrawn - CHG 19.

(2) Withdrawn - CHG 19.

(3) Serves as the focal point on matters relating to aircraft noise, sonic boom, fuel venting, and exhaust emission standards.

(4) Serves as a focal point on research and development projects relative to airworthiness, including aircraft engineering, manufacturing, and maintenance.

(5) Withdrawn - CHG 19.

(6) Serves as a focal point on National Transportation Safety Board Recommendations relative to airworthiness, including aircraft engineering, manufacturing, and maintenance.

i. Directs and manages the National Resource Specialist Program established by Order 8000.45, Aircraft Certification National Resource Specialist, to ensure the efficient, effective, and economical utilization of the specialist in conducting certification programs.

6311. AIRCRAFT MANUFACTURING DIVISION

a. The division is responsible for the production certification of manufacturers (all forms of production approval), original airworthiness certification of civil aircraft; the airworthiness approval of new engines, propellers, materiels, parts and appliances; and the identification and marking of civil aeronautical products for airworthiness control (excluding registration); policy related to prototype article conformity inspection, experimental certification, and related reports in support of the Aircraft Engineering Division in the type certification of aircraft, engines, propellers; and enforcement of the regulations associated with all of the foregoing.

b. With respect to the foregoing, the division:

(1) Develops, assesses the justification for, and evaluates the technical substance of, Federal Aviation Regulations, minimum standards, and Appendices to Federal Aviation Regulations.

(2) Recommends granting or denying exemption petitions.

(3) Supports rulemaking actions by providing or arranging for technical specialist participation.

(4) Develops, coordinates, and recommends national policies.

(5) Develops, coordinates, and issues national directives to provide technical guidance on procedures, practices, and program plans.

(6) Serves as a point of contact for the public on issues appropriate to the national level.

(7) Conducts evaluations and analyses of field program accomplishment.

(8) Assesses the need for and recommends priorities on

research and development activities.

(9) Assigns special technical projects, recommends priorities, and provides broad policy and program guidance to ensure the adequacy of the national production certification activities performed by the Aviation Standards National Field Office.

(10) Represents the Office in international meetings to further U.S. interests and to develop International Standards and Recommended Practices for ICAO.

(11) Represents the Office in matters concerning the development of international agreements, arrangements, policies, and practices involving the airworthiness approval and acceptance of civil aircraft and related products.

6312 AIRCRAFT MAINTENANCE DIVISION

a. Is the principal element of the Office with respect to the maintenance aspects of the certification and surveillance of operators, airmen, and air agencies; and the maintenance performance standards and practices applied to assure the continued airworthiness of civil aircraft.

b. With respect to the foregoing:

(1) Assesses the justification for, and evaluates the technical substance of Federal Aviation Regulations, and Appendices to Federal Aviation Regulations.

(2) Recommends granting or denying exemption petitions.

(3) Supports rulemaking actions by providing or arranging for technical specialist participation.

(4) Develops, coordinates, and recommends national policies.

(5) Develops, coordinates, and issues national directives to provide technical guidance on procedures and practices.

(6) Serves as a point of contact for the public on issues appropriate to the national level.

(7) Conducts evaluations and analyses of field program accomplishment.

(8) Assesses the need for, and recommends priorities on, research and development activities.

(9) Represents the Office in matters concerning the development of international agreements, arrangements, policies,

and practices involving airmen and air agencies.

(10) Represents the Office in international meetings to further U.S. interests and to develop International Standards and Recommended Practices for ICAO.

(11) Assigns special technical projects, recommends priorities, and provides broad policy and program guidance to ensure the adequacy of the maintenance project activities performed by the Aviation Standards National Field Office.

c. Reviews the substance of and recommends final action on requests for reconsideration on original issuance, amendment, or refusal to issue or amend a maintenance airman or air agency certificate.

d. Reviews the substance of and recommends final action on any petition for reconsideration or original issuance, amendment, or refusal to issue and amend an Operations Specification with respect to maintenance.

e. Develops, coordinates, and recommends career development programs to assure organizational competency for aviation safety inspectors (airworthiness GS-1825).

1.2.2 SECTION 2. OFFICE OF THE REGIONAL DIRECTOR

210. REGIONAL DIRECTOR The Regional Director is the principal representative of the Administrator in an FAA region. The Director serves as the operating head of all organizations and functions of the agency authorized in the region. The Director is responsible for achieving agency program objectives and goals within the assigned geographical area and for formulating and recommending programs, policies, and standards to satisfy current and anticipated future air transportation requirements within the region. The appraisal, communications control, and planning functions are assigned to the Office of the Regional Director and may be organizationally placed elsewhere at the discretion of the Director.

211. MISSION AND FUNCTIONS Each region executes the programs of the Federal Aviation Administration, including assigned international operations, as they apply within the region in order to provide for safe and expeditious movement of aircraft, insure air safety, and promote aviation in the United States and abroad.

212. AIRCRAFT CERTIFICATION DIRECTORATES

a. The Regional Directors of the New England, Central, Southwest, and Northwest Mountain Regions also serve as heads of Aircraft Certification Directorates. The term Aircraft Certification Directorate means the organization formed and staffed for the purpose of managing the various elements of the aircraft certification program. Each of these Regional Directors

has final authority and responsibility for the certification program assigned.

(1) The Small Airplane Certification Directorate has regulatory responsibility for FAR Part 23 (both national and international). The directorate is an element of the Central Region and consists of the previously designated engineering and manufacturing branches and district offices located within the Great Lakes, Southern, and Central Regions. Geographical areas of responsibility include the States, territories, and oceanic areas located within the boundaries of the Great Lakes, Southern and Central Regions.

(2) The Transport Airplane Certification Directorate has regulatory responsibility for FAR Part 25 (both national and international). The Directorate is an element of the Northwest Mountain Region and consists of the previously designated engineering and manufacturing branches and district offices located in the Western Pacific, Alaskan, and Northwest Mountain Regions. Geographical areas of responsibility include the States, territories, and oceanic areas located within the boundaries of the Western-Pacific, Alaskan, and Northwest Mountain Regions.

(3) The Rotorcraft Certification Directorate has regulatory responsibility for FAR Parts 27 and 29 (both national and international). The Directorate is an element of the Southwest Region and consists of the previously designated engineering and manufacturing branches and district offices located in the Southwest Region. Geographical areas of responsibility include the States, territories, and oceanic areas located within the boundaries of the Southwest Region.

(4) The Engine and Propeller Certification Directorate has regulatory responsibility for FAR Part 33 and 35 (both national and international). The Directorate is an element of the New England Region and consists of the Aircraft Certification Staff in the Europe, Africa, and Middle East Office, previously designated engineering and manufacturing branches, and district offices located in the Eastern and New England Regions. Geographical areas of responsibility include the States, territories, and oceanic areas located within the boundaries of the Europe, Africa, and Middle East Office, the Eastern, and New England Regions.

SECTION 2.0

MILITARY SPECIFICATIONS: DEVELOPMENT AND DIFFERENCES FROM FARs

2.1 MILITARY SPECIFICATION DEVELOPMENT

Military specifications are developed along guidelines for format and content defined in MIL-STD-490, "Specification Practices." The specification development practices presented in MIL-STD-490 are primarily aimed at the development and procurement of military systems. Therefore, they do not always lend themselves to specifying detailed technical information on generalized systems (such as a general specification for aircraft structures.)

MIL-STD-490 format calls for definition of requirements in Section 3, and for definition of verification methods in Section 4. Additional clarifying information may be provided in Notes in Section 6. MIL-A-87221 (USAF) has been developed to MIL-STD-490 guidelines, but does not fit neatly into MIL-STD-490 definitions of Type A, Type B, or Type C specifications. MIL-STD-490 guidelines for defining requirements, techniques, and accepted practices for accomplishing design goals are defined in detail in Section 3, and verification methods assure that the Section 3 requirements are verified by analysis, demonstrations, or tests defined in Section 4. However, MIL-A-87221 (USAF) deviates from standard MIL-STD-490 practices by providing numerous blanks to be filled in for specific aircraft procurements, and in providing voluminous background materials and lessons learned in appendices.

2.2 FEDERAL AVIATION REGULATIONS

The Federal Aviation Regulations tend to define design requirements in terms of meeting performance requirements, rather than in the detailed definition of design requirements. For example, paragraph 23.629 in FAR 23 defines flutter requirements. This "paragraph" takes up less than one full page. The general statement of the flutter requirements is that "It must be shown by one of the methods specified . . . that the airplane is free from flutter, control reversal, and divergence for any condition of operation . . ." The rest of the flutter paragraph then defines the parameters that the aircraft must meet for a successful verification of the flutter requirement.

MIL-A-87221 (USAF) is much more closely parallel to the FARs than were the MIL-A-00886X series of specifications which it supersedes. MIL-A-87221 (USAF) provides general statements of requirements in general terms with blanks allowed for tailoring for specific aircraft procurements. The MIL-A-00886X series of specifications embodied much greater detail in specific technical requirements, limiting design flexibility.

It should be noted that, in general, the FARs do not differentiate quality assurance requirements from the technical requirement itself. There is no clear specification Section 3 - Section 4 one-to-one correspondence such as is called out in MIL-STD-490. Therefore, it can generally be assumed that the FAR reference shown in the Matrix on the following pages applies not only to the MIL-A-87221 Section 3 requirement, but also to it's corresponding MIL-A-87221 Section 4 quality assurance requirement as well.

SECTION 3.0

COMPARISON OF MIL-A-87221 REQUIREMENTS TO REQUIREMENTS OF
FAA FAR 23 AND FAR 25

<u>MIL Spec Para/Title</u>	<u>FAR 23</u>	<u>FAR 25</u>
3.1 Detailed Structural Criteria	23.1 Applicability 23.301 Loads	25.1 Applicability 25.301 Loads
3.2 General Parameters	23.305 Strength and Deformation	25.305 Factor of Safety 25.305 Strength and Deformation
3.2.1 Airframe Configuration	23.301 Loads	25.301 Loads 25.345 High Lift Devices 25.459 Special Devices 25.457 Flaps, Wing
3.2.2 Cargo	23.305 Strength and Deformation	25.793 Floor Surfaces 25.789 Retention of Item of Mass, et cetera
3.2.3 Payloads	23.301 Loads 23.305 Strength and Deformation	25.301 Loads 25.305 Strength and Deformation 25.793 Floor Surfaces
3.2.4 Weight Distribution	23.23 Load Distribution	25.1519 Weight Center of Gravity and Weight Distribution
3.2.5 Weights	23.25 Weight Limits	25.25 Weight Limits 25.523 Design Weight and Center of Gravity Position
3.2.5.1 Maximum Zero Fuel Weight	None	None
3.2.5.2 Minimum Flight Weight	None	None

<u>MIL Spec Para/Title</u>	<u>FAR 23</u>	<u>FAR 25</u>
3.2.5.3 Normal Flight Weight	23.23 Load Distribution 23.25 Weight Limits	25.23 Load Distribution 25.25 Weight Limits 25.29 Empty Weight and Corresponding Center of Gravity
3.2.5.4 Maximum Flight Weight	None	None
3.2.5.5 Normal Landing Weight	23.473 Ground Loads and Assumptions	25.473 Ground loads and Assumptions 25.511 Ground Load: Unsymmetrical Loads on Multiple Wheel Units
3.2.5.6 Maximum Landing Weight	23.25 Weight Limits	25.25 Weight Limits
3.2.5.7 Maximum Ground Weight	23.473 Ground Load Conditions	25.473 Ground Load Conditions
3.2.5.8 Maximum Lift Off Weight	23.23 Load Distribution Limits 23.25 Weight Limits	25.23 Load Distribution Limits 25.25 Weight Limits 25.27 Center of Gravity Limits
3.2.5.9 Maximum Landing Gear Jacking Weight	23.507 Jacking Loads	None
3.2.5.10 Maximum Airframe Jacking Weight	23.507 Jacking Loads	None
3.2.5.11 Hoisting Weight	None	None
3.2.5.12 Other Weights	None	None

<u>MIL Spec Para/Title</u>	<u>FAR 23</u>	<u>FAR 25</u>
3.2.6 Center of Gravity Position	23.23 Load Distribution Limits 23.25 Weight Limits	25.23 Load Distribution Limits 25.25 Weight Limits 25.27 Center of Gravity Limits
3.2.7 Speeds	23.1505 Airspeed Limitations	25.1503 Airspeed Limitations, General
3.2.7.1 Level Flight Maximum Speed	23.335 Design Airspeed	25.335 Design Airspeed 25.1505 Maximum Operating Limit Speed
3.2.7.2 Dive Speed	23.335 Design Airspeed	25.335 Design Airspeed
3.2.7.3 Limit Speed	23.335 Design Airspeed	25.335 Design Airspeed 25.1505 Maximum Operating Limit Speed
3.2.7.4 Maneuver Speed	23.335 Design Airspeed 23.337 Limit Maneuvering Load Factor	25.1507 Maneuvering Speed 25.337 Limit Maneuvering Load Factor
3.2.7.5 Takeoff, Approach and Landing Limit Speed	23.345 High Lift Devices	25.107 Takeoff Speeds 25.335 Design Airspeed 25.345 High Lift Devices
3.2.7.6 Lift Off Limit Speed	23.51 Takeoff Speed	25.1513 Minimum Control Speeds
3.2.7.7 Touch Down Limit Speed	23.49 Stalling Speed	25.1515 Landing Gear Speeds
3.2.7.8 Taxi Limit Speed	None	None
3.2.7.9 Gust Limit Speed	23.333 Flight Envelope	25.341 Gust Loads 25.333 Flight Envelope

<u>MIL Spec Para/Title</u>	<u>FAR 23</u>	<u>FAR 25</u>
3.2.7.10 Probable Failure Limit Speed	None	None
3.2.7.11 Other Speeds	None	None
3.2.8 Altitudes	23.1527 Maximum Operating Altitude	25.1527 Maximum Operating Altitude
3.2.8.1 Maximum Flight Altitude	23.1527 Maximum Operating Altitude	25.1527 Maximum Operating Altitude
3.2.8.2 Maneuver Altitude	None	None
3.2.8.3 Maximum Ground Altitude	None	None
3.2.9 Flight Load Factors	23.333 Flight Envelope 23.337 Limit Maneuvering Load Factors 23.441 Maneuvering Loads (Test) 23.423 Maneuvering Loads (Test)	25.301 Loads 25.333 Flight Envelope 25.337 Limit Maneuvering Load Factors
3.2.9.1 Normal Flight Weight Load Factors	23.333 Flight Envelope	25.333 Flight Envelope
3.2.9.2 Maximum Flight Weight Load Factors	23.333 Flight Envelope	25.333 Flight Envelope
3.2.9.3 Takeoff, Approach, and Landing Load Factors	Appendix C	25.333 Flight Envelope 25.337 Limit Maneuvering Load Factors
3.2.9.4 High Drag Load Factors	23.345 High Lift Devices 23.373 Speed Control Devices	25.345 High Lift Devices 25.459 Speed Control Devices

<u>MIL Spec Para/Title</u>	<u>FAR 23</u>	<u>FAR 25</u>
3.2.9.5 Air Vehicle Load Factors After Probable Failures	None	25.571 Damage Tolerance and Fatigue Evaluation of Structure
3.2.9.6 Other Flight Load Factors	23.347 Unsymmetrical Flight Conditions	25.349 Rolling Conditions 25.351 Yawing Conditions
3.2.10 Ground Loading Parameters	23.471 General, Ground Loads 23.471 Ground Load Conditions	25.473 Ground Load Conditions and Assumptions
3.2.10.1 Landing Sink Speeds	23.479 Level Landing Conditions	25.479 Level Landing Conditions
3.2.10.2 Landing Crosswinds	23.483 One Wheel Landing Conditions 23.485 Side Load Conditions	25.483 One wheel Landing Conditions 25.485 Side Load Conditions
3.2.10.3 Landing Roll, Yaw and Pitch Attitudes	23.349 Rolling Conditions 23.351 Yawing Conditions	None
3.2.10.4 Taxi, Discrete Bumps and Dips	None	None
3.2.11 Limit Loads	23.305 Strength and Deformation 23.333 Flight Envelope 23.337 Limit/Maneuvering Load Factor	25.301 Loads 25.305 Strength and Deformation 25.333 Flight Envelope
3.2.12 Ultimate Loads	23.305 Strength and Deformation	25.303 Factor of Safety 25.305 Strength and Deformation
3.2.12.1 Manned Air Vehicles	None	None
3.2.12.2 Unmanned Air Vehicles	None	None

<u>MIL Spec Para/Title</u>	<u>FAR 23</u>	<u>FAR 25</u>
3.2.13 Deformation	23.305 Strength and Deformation	25.305 Strength and Deformation
3.2.14 Service Life and Usage	Appendix G	Appendix H
3.2.14.1 Service Representative Airport or Base	None	None
3.2.14.2 Repeated Loads Sources	23.341 Gust load Factor 23.337 Limit Maneuvering Load Factors 23.507 Jacking Loads 23.509 Towing Loads	25.341 Gust loads 25.337 Limit Maneuvering Load factors 25.571 Damage Tolerance and Fatigue Evaluation of Structure
3.2.14.3 Other Requirements	Appendix G	None
3.2.15 Atmosphere	23.45 General, Performance	25.101 General Performance
3.2.16 Chemical, Thermal, and Climatic Environments	None	None
3.2.17 Power or Thrust	23.901 Installation, Powerplant	25.901 Installation, Powerplant
3.2.18 Flight Control and Augmentation Devices	23.1329 Auto Pilot System 23.391 Control Surface Loads	25.1329 Automatic Pilot System 25.391 Control Surface Loads, General 25.459 Special Devices
3.2.19 Material and Processes	23.603 Materials and Workmanship	25.603 Materials 25.613 Materials Strength Properties and Design Values
3.2.20 Finishes	23.609 Protection of Structure	25.609 Protection of Structure

<u>MIL Spec Para/Title</u>	<u>FAR 23</u>	<u>FAR 25</u>
3.2.21 Non-Structural Coatings, Films and Layers	23.609 Protection of Structure	25.609 Protection of Structure
3.2.22 Probable Failures	None	25.571 Damage Tolerance and Fatigue Evaluation of Structure
3.2.22.1 Tire Failures	See FAA TSO for Tires, (Technical Standard Order C62c)	See TSO-C62c
3.2.22.2 Propulsion System	23.939 Powerplant Operating Characteristics	25.939 Turbopropeller - Drag Limiting Systems
3.2.22.3 Radome Failures	None	None
3.2.22.4 Access Doors and Components	23.611 Accessibility Provisions	25.611 Accessibility Provisions
3.2.22.5 Structural or Mechanical Failures	None	25.629 Flutter Deformation and Fail Safe Criteria 25.571 Damage Tolerance
3.2.22.6 Hydraulic Failures	None	25.1435 Hydraulic System
3.2.22.7 Engine Support Failures	23.321 Flight Loads General 23.361 Engine Torque 23.363 Side Load on Engine Mount	25.361 Engine Torque Loads 25.363 Side Load on Engine Mount
3.2.22.8 Flight Control System Failures	23.395 Control System Loads	25.395 Control Systems 25.399 Dual Control Systems
3.2.22.9 Transparency Failures	23.775 Windshields and Windows	25.775 Windshields and Windows

<u>MIL Spec Para/Title</u>	<u>FAR 23</u>	<u>FAR 25</u>
3.2.22.10 Rapid Decom- pression	23.841 Pressurized Cabins 23.843 Pressuriza- tion Test	25.841 Pressurized Cabins 25.843 Test for Pressurized Cabins
3.2.22.11 Other Failures	None	None
3.2.23 Lightning Strikes	23.867 Lightning Protection of Structure	25.581 Lightning Protection
3.2.24 Foreign Object Damage	None	None
3.3 Design and Construction Parameters	23.601 Design and Construction General (through) .629 Flutter	25.601 General
3.3.1 Doors and Panels	23.783 Doors 23.807 Emergency Exits	25.783 Door 25.807 Passenger Emergency Exits
3.3.2 Doors and Ramps Mechan- isms of Pressurized Compartments	23.841 Pressurized Cabins 23.843 Pressuri- zation Tests	25.841 Pressurized Cabins 25.843 Tests for Pressurized Cabins
3.3.3 Ramps	None	None
3.3.4 Cargo Floors	23.787 Cargo Compartments	25.793 Floor Surfaces
3.3.5 Transparencies (see 3.2.22.9)	23.775 Windshield and Windows	25.775 Windshields and Windows
3.3.6 Tail Bumper	None	None
3.3.7 Tail Hook	None	None
3.3.8 Vents and Louvers	None	None
3.3.9 Cavities	None	None
3.3.10 Armor	None	None

<u>MIL Spec Para/Title</u>		<u>FAR 23</u>		<u>FAR 25</u>
3.3.11 Refueling Provisions		None		None
3.3.12 Cables		23.395 Control System Loads		25.397 Control System Loads
		23.689 Cable Systems		25.689 Cable Systems
3.3.13 Airframe Bearings and Pulleys		23.395 Control System Loads		25.397 Control System Loads
		23.689 Cable Systems		25.689 Cable Systems
3.3.14 Fasteners		23.605 Fabrication Methods		25.605 Fabrication Methods
		23.607 Self Locking Nuts		25.607 Fasteners
3.3.15 Integral Fuel Tanks and Lines		23.963 Fuel Tanks, General		25.963 Fuel Tanks, General
3.3.16 Nuclear Weapons Retention		None		None
3.3.17 Other Design and Construction Parameters		23.619 Special Factors, etc.		25.619 Special Factors
		23.621 Casting Factors		25.621 Casting Factors
				25.623 Bearing Factors
				25.625 Fitting Factors
3.4 Structural Loading Conditions		23.301 Loads General		25.301 Loads
		23.321 Flight Loads, General		25.321 General
		23.305 Strength and Deformation		
3.4.1 Flight Loading Conditions		23.301 Flight Loads, General		25.321 General
				25.333 Flight Envelopes
3.4.1.1 Symmetric Maneuvers		23.331 Symmetrical Flight Conditions		25.333 Flight Envelope Limit
				25.337 Maneuvering Load Factors
3.4.1.2 Asymmetric Maneuvers		23.347 Unsymmetrical Flight Conditions		25.349 Rolling Conditions
		23.367 Unsymmetrical Loads Due to Engine Failures		25.351 Yawing Conditions
				25.427 Unsymmetrical Loads

<u>MIL Spec Para/Title</u>	<u>FAR 23</u>	<u>FAR 25</u>
3.4.1.3 Directional Maneuvers	23.349 Rolling Conditions	25.349 Rolling Conditions
	23.351 Yawing Conditions	25.351 Yawing Conditions
	23.371 Gyroscopic Loads	25.371 Gyroscopic Loads
3.4.1.4 Evasive Maneuvers	None	None
3.4.1.5 Other Maneuvers, (Stalls, Spins, etc.)	23.333 Flight Envelope	25.333 Flight Envelope
		25.203 Stall Characteristics
		25.201 Stall Demonstration
		25.205 Stalls, Critical Engine Inoperative
3.4.1.6 Turbulence	23.341 Gust Load Factors	25.341 Gust Loads
	23.425 Gust Loads	25.415 Ground Gust Conditions
	23.443 Gust Loads	
3.4.1.7 Aerial Refueling (see 3.3.11)	None	None
3.4.1.8 Aerial Delivery	None	None
3.4.1.9 Speed and Lift Control	23.345 High Lift Devices	25.345 High Lift Devices
	23.373 Speed Control Devices	25.373 Speed Control Devices
3.4.1.10 Braking Wheels in Air	None	None
3.4.1.11 Extension and Retraction of Landing Gear	23.729 Landing Gear Extension and Retraction System	25.729 Retracting Mechanism

<u>MIL Spec Para/Title</u>	<u>FAR 23</u>	<u>FAR 25</u>
3.4.1.12 Pressurization	23.571 Pressurized Cabin 23.572 Wing and Associated Structure 23.841 Pressurized Cabin 23.843 Pressurization Test	25.365 Pressurized Cabin Loads 25.841 Pressurized Cabin 25.843 Tests for Pressurized Cabins
3.4.1.13 Other Flight Conditions	(Subpart C)	Appendix C
3.4.2 Ground Loading Conditions	23.471 Ground Loads, General 23.473 Ground Load Conditions	25.471 General 25.473 Ground Load Conditions and Assumptions
3.4.2.1 Taxi	23.471 Ground Loads, General	25.471 General
3.4.2.2 Tires	23.485 Side Load Conditions	25.495 Turning 25.497 Tail Wheel Yawing 25.499 Nose Wheel Yaw
3.4.2.3 Pivots	None	25.503 Pivoting
3.4.2.4 Braking	23.493 Braked Roll Conditions	25.493 Braked Roll Conditions
3.4.2.5 Takeoffs	23.51 Takeoffs	25.105 Takeoff 25.107 Takeoff Speeds
3.4.2.6 Landings	23.75 Landing	25.125 Landing
3.4.2.7 Ski Equipped Air Vehicles	23.505 Supplementary Conditions for Ski-Planes	25.737 Skis
3.4.2.8 Maintenance	23.603 Materials and Workmanship	25.611 Accessibility Provisions Appendix H
3.4.2.9 Ground Winds	None	25.415 Ground Gust Conditions

<u>MIL Spec Para/Title</u>	<u>FAR 23</u>	<u>FAR 25</u>
3.4.2.10 Crashes	23.561 Emergency Landing Conditions	25.561 Emergency Landing Conditions, General 25.563 Structural Ditching Provisions
3.4.2.11 Other Ground Loading Conditions	None	None
3.5 Aeroacoustic Durability	23.627 Fatigue Strength	25.571 Damage Tolerance and Fatigue Evaluation of Structure
3.5.1 Structure	23.627 Fatigue Strength	25.301 Loads 25.303 Factor of Safety 25.305 Strength and Deformation
3.5.2 Systems	23.1301 Function and Installation (Equipment General)	25.1301 Function and Installation
3.5.3 Internal noise	23.771 Pilot Compartment	25.571 Damage Tolerance and Fatigue Evaluation of Structure
3.6 Vibration	See below	See below
3.6.1 Structure, Vibration	23.251 Vibration and Buffeting	25.251 Vibration and Buffeting 25.253 High-Speed Characteristics 25.343 Design Fuel and Oil Loads 25.875 Reinforcement Near Propellers

<u>MIL Spec Para/Title</u>	<u>FAR 23</u>	<u>FAR 25</u>			
3.6.2 Propulsion, Vibration	23.251	Vibration and Buffeting	25.251	Vibration and Buffeting	
	23.907	Propeller Vibration	25.907	Propeller Vibration	
	23.909	Turbo Super-Chargers	25.939(c)	Turbine Engine Operating Characteristic	
	23.1123(b)	Exhaust Manifold	25.945(b)(1)	Thrust or Power Augmentation	
	23.1189(c)	Power-Plant Fire Protection	25.1123(b)	Exhaust Piping	
	23.1193(a)	Cowling and Nacelle	25.1125(a)	Exhaust Heat Exchange	
	23.1203(b)	Fire Detector System	25.1141(d)	Powerplant Controls (General)	
			25.1193(a)	Cowling and Nacelle Skin	
	3.6.3 Systems (Vibration)	23.251	Vibration and Buffeting	25.251	Vibration and Buffeting
		23.965(b)	Fuel Tank Test	25.253	High-Speed Characteristics
23.993(a)		Fuel System Lines and Fittings	25.963(a)	Fuel Tanks (General)	
			25.993(a)	Fuel System Lines and Fittings	
23.1023		Oil Radiators	25.1015(a)	Oil Tank Tests	
23.1061(e)		Installation	25.1023(a)	Oil Radiators	
23.1367(b)		Switches	25.1107	Inter-Coolers and After-Coolers	
23.1461(b)		Equipment Containing High-Energy Rotors	25.1327(b)	Magnetic Direction Indicator	
			25.1435	Hydraulic System	
			25.1461(b)	Equipment Containing High-Energy Rotors	

<u>MIL Spec Para/Title</u>	<u>FAR 23</u>	<u>FAR 25</u>
3.6.4 Ride quality (Vibration)	23.251 Vibration and Buffeting	25.251 Vibration and Buffeting
	23.1321(c) Instru- ments Install- ation	25.253 High-Speed Character- istics 25.771(e) Pilot Compartment 25.1321(d) Instruments Installation
3.7 Aeroelastic Stability	23.629 Flutter	25.629 Flutter, Deformation, and Fail-Safe Criteria
3.7.1 Aeroelasticity		
3.7.2 Aeroservoelas- ticity	<u>CONTROL SURFACES</u>	
3.7.3 Damping	23.651 Proof-of- Strength	25.651 Proof-of- Strength
3.7.4 Failsafe Stability	23.655 Installation	25.655 Installation
3.7.5 Margins	23.657 Hinges	25.657 Hinges
3.7.6 Environmental Effects	23.659 Mass Balance	
	<u>CONTROL SYSTEMS</u>	
	23.671 General	25.671 General
	23.673 Primary Flight Control	25.672 Stability Augmentation and Automatic and Power Operated Systems
	23.675 Stops	
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	23.679 Control System Locks	25.673 Two-Control Airplane 25.675 Stops
	23.681 Limit Load	25.677 Trim Systems
	23.683 Operation Tests	25.679 Control System Gust Locks 25.681 Limit Load Static Tests
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	23.685 Control System Details	25.685 Control System Details
	23.687 Spring Devices	25.687 Cable Systems 25.693 Joints
	23.689 Cable Systems	25.697 Lift and Drag Devices, Controls
	23.693 Joints	
	23.697 Wing Flap Controls	25.699 Lift and Drag Device Indicator
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	23.701 Flap Inter- Connection	25.703 Takeoff Warning System

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3.8 Required Structure Survivability - Nuclear	None	None
3.9 Required Structure Survivability - Nonnuclear	None	25.571 Damage Tolerance and Fatigue Evaluation of Structure
3.10 Strength	23.301 Loads	25.303 Factor of Safety
3.10.1 Metallic Materials	23.303 Factor of Safety	25.305 Strength and Deformation
3.10.1.1 Material Properties	23.305 Strength and Deformation	25.307 Proof-of-Structure
3.10.1.2 Castings	23.307 Proof of Structure	25.601 Design and Construction, General
3.10.1.3 Forgings	23.603 Materials and Workmanship	25.603 Materials
3.10.1.4 Grain Direction	23.605 Fabrication Methods	25.605 Fabrication Methods
3.10.1.5 Environmental Effects	23.609 Protection of Structure	25.613 Material Strength Properties and Design Values
3.10.1.6 Fitting Factor	23.613 Material Strength Properties and Design Values	25.615 Design Properties
3.10.1.7 Bearing Factor	23.615 Design Properties	25.621 Casting Factors
3.10.2 Non-Metallic Materials	23.619 Special Factors	25.623 Bearing Factors
3.10.3 Internal Loads	23.621 Casting Factors	25.625 Fitting Factors
3.10.4 Stresses	23.623 Bearing Factors	25.693 Joints
3.10.5 Static Strength	23.625 Fitting Factors	
3.10.6 Interim Strength Flight Release	23.627 Fatigue Strength	
3.10.7 Final Strength Flight Release		
3.10.8 Structural Modifications		

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3.11 Durability	23.571 Fatigue	25.571 Fatigue
3.11.1 Fatigue Cracking/ Damage	Evaluation Pressurized Cabin	Evaluation Damage Tolerance
3.11.2 Corrosion Prevention	23.572 Fatigue Evaluation	and Fatigue Evaluation of
3.11.3 Thermal Protection Assurance	Wing and Associated Structure	25.609 Protection of Structure
3.11.4 Wear	23.603 Material and Workmanship	25.611 Accessibility Provisions
3.11.5 Limited Life Structure	23.609 Protection of Structure	25.1041 Cooling General
	23.611 Accessibility	25.1043 Cooling Tests
	23.613 Material Strength Properties and Design Values	25.1045 Cooling Test Procedures
3.12 Damage Tolerance	23.571 Fatigue Evaluation	25.571 Fatigue Evaluation
3.12.1 Flaw Sizes	Pressurized Cabin	Damage Tolerance and
3.12.2 Residual Strength and Damage Growth Limits	23.572 Fatigue Evaluation	Fatigue Evaluation of
3.12.2.1 Slow Crack Growth Structure	Wing and Associated Structure	25.615 Design Properties
3.12.2.2 Fail Safe Multiple Load Path Structure		25.619 Special Factors
3.12.2.3 Fail Safe Crack Arrest Structure		25.620 Flutter, Deformation and Fail Safe Criteria
		25.841 Pressurization: Pressurized Cabins
		25.843 Tests for Pressurized Cabins
3.13 Force Management	None	25.1457 Cockpit Voice Recorders
3.13.1 Data Acquisition Systems		25.1459 Flight Recorders